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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/603,147	06/23/2000	John T. Moore	MI22-1443	3541

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EXAMINER
KIELIN, ERIK J

ART UNIT	PAPER NUMBER
2813	25

DATE MAILED: 03/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/603,147	Applicant(s) MOORE ET AL.	
	Examiner Erik Kielin	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 March 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *76,81,97 and 98* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *76,81,97 and 98* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *24* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 14 March 2003 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 76, 81, 97, and 98 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of US 6,136,700 (**McAnally** et al.) and US 5,935,873 (**Spuler** et al.).

AAPA clearly discloses each of the features of the DRAM including a semiconductor substrate **12**, the three nodes **14**, **16**, **18** in gated electrical connection via wordlines **20**, **22** with sidewalls **28**, **30** (i.e. the wordlines are the conductive gates controlling the connection between the capacitors and the storage nodes); capacitor constructions **36**, **38** formed in the openings of and directly against the insulating layer **34** --which may be BPSG as further limited by instant claim 98-- and directly against the substrate **12**; bit line contact **46**; the etch stop **32** formed over,

along, and proximate the wordlines and extending along and against a portion of the storage node (first electrode **40**). Each capacitor construction comprises a storage node (first electrode) **40** formed of conductively doped polysilicon (specification, p. 4, lines 16-18), dielectric **42**, and second electrode **44**. (See Prior Art Figures 1-4 and specification, section entitled, Background of Invention" -- especially pp. 5-8. Compare especially **AAPA** prior art Fig. 1 with non-prior art Fig. 7.)

The **AAPA** is silent to (1) the sidewall spacer material consisting essentially of a material having carbon, silicon, and oxygen and (2) the insulating layer being in contact with at least one of the carbon-containing sidewall spacers.

Regarding (1), **McAnally** teaches forming either or both the sidewall spacers **108** and etch stop **110** from the aforementioned composition containing carbon, silicon, and oxygen and can comprise silicon carbide --as further limited by instant claim 81-- to improve etch selectivity specifically for etching a storage node contact. Regarding (2) **McAnally** teaches that the etch stop layer **110** may be omitted because the sidewall spacers are made of the etch-resistant carbon-containing material and that this beneficially eliminates an etch step. (See Abstract; col. 3, lines 37-40; claim 3; col. 5, lines 10-43; col. 6, lines 25-31.)

It would have been obvious to one of ordinary skill at the time of the invention was made to use the sidewall spacer material of **McAnally** for the sidewall spacer material of **AAPA** for the reasons indicated in **McAnally** --especially to protect to the gate structure from being damaged during etching of the opening for the storage node contact. It would be obvious to have the insulative material **34** of **AAPA** directly contacting one of the sidewall spacers (i.e. omitting

the etch stop layer **32**) to beneficially reduce the number of etch steps, as taught to be beneficial in **McAnally**.

Then the only difference is that neither **AAPA** nor **McAnally** indicates the amount of carbon in the sidewall spacers to be "from about 2% to about 20% carbon."

Spuler teaches the appropriate amount of carbon in an etch resistant material for providing good selectivity relative to non-carbon containing dielectric materials is 1 to 50% or preferably 10% to 30% *to provide good etch selectivity* relative to an oxide layer **30**, deposited thereover. (See col. 2, l. 39 to col. 3, l. 35.)

It would have been obvious to one of ordinary skill at the time of the invention to use the carbon content taught by **Spuler** in the sidewall spacers of **AAPA** in view of **McAnally** because both **McAnally** and **Spuler** teach carbon-containing etch stop materials to protect the gate electrodes during node etching. **McAnally** is silent to the quantity of carbon, such that one of ordinary skill would be especially motivated to apply the teaching of **Spuler** since the carbon-containing materials are being used for exactly the same purposes in both **McAnally** and **Spuler**.

Further in this regard, although the carbon quantity is not exactly as claimed by Applicant, overlapping ranges are *prima facie* obvious in the absence of unexpected results. (See MPEP 2144.05.) In this case, there exists no unexpected result. Rather the result indicated in the instant specification is exactly the same as in each of **McAnally** and **Spuler**: etch selectivity is provided by adding carbon to the etch stop and/or the sidewall spacer materials which enables protection of the gate electrode during etching of the node contact.

Regarding claim 97, **AAPA** and **McAnally** do not teach that the sidewall spacers have a thickness of less than about 500 Å. However, **McAnally** further indicates that a success of the invention is that "the invention allows for maximizing the area on the substrate that is in contact with a self-aligned contact" and that "the large contact area reduces the contact resistance and therefore increases the performance of the semiconductor device." (See col. 2, lines 18-27.) And more pertinently, **McAnally** states, "Thus the use of an appropriate material for stopping layer **110** may allow the use of thinner films for the insulating film **106** and *the sidewall [spacers]* **108**, which increases contact area and improves planarity." (See col. 4, lines 42-45; Italicized emphasis added.) **McAnally** explicitly suggests minimizing the width of the sidewall spacers **108** which directly affect the contact area. The greater etch selective materials enable narrower or thinner sidewall spacers and etch stops because, as indicated in **McAnally**, the etch selectivity is greater between the carbon-containing materials and the non-carbon-containing materials. Accordingly, it would have been obvious for one of ordinary skill in the art, at the time of the invention to choose a sidewall spacer width of less than 500 Å in order to increase the contact area in accord with the **McAnally** invention and to thereby provide greater contact area in the **AAPA** contact. (Compare this with the instant specification paragraphs bridging pages 14-15 and 22-23, which conveys virtually the same concept as McAnally.)

Furthermore, the selection of the sidewall spacer thickness is *prima facie* obvious because it is a matter of determining optimum process condition by routine experimentation with a single variable, i.e. the thickness of the sidewall spacers within the implicit suggestion of **McAnally** which indicates that carbon-containing sidewall spacers and etch stops are more etch

selective, which implicitly indicates that said materials can perform the same etch-prevention function with less of the material. (See MPEP 2144.05.)

Furthermore, as devices shrink, so do the dimensions of the features of each device according to Moore's Law. Accordingly, the choice of sidewall spacer thickness is merely a matter of routine optimization, as indicated above. Applicant has not recognized an advantage not already known in the art regarding the thickness of the spacers. In other words, one of ordinary skill would not continue to use sidewall spacers of a thickness used in a 1-μm rule, for devices in a 0.18-μm rule; instead, the size of all of the features, particularly the sidewall spacers, would be necessarily be scaled down.

Further regarding the width of the sidewall spacers, **Spuler** col. 2, lines 40-48, discloses the dimension of the opening, which is as small as 500 Å (0.05 μm) wide. It is clear then that the **Spuler** sidewall spacer portion of the etch stop layer are less than 500 Å; otherwise they would close off the contact. More specifically, the sidewall spacer portion of the etch stop layer is indicated to be 200 Å to 300 Å.

It would have been obvious to one of ordinary skill at the time of the invention to choose the sidewall spacer thickness in the **AAPA** to be less than 500 Å, depending upon the size of the opening between the wordlines, in order to optimize the sidewalls relative to the device being formed, and for the reasons just indicated above.

Response to Arguments

4. Applicant's arguments with respect to claims 76, 81, 97, and 98 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Erik Kielin
March 21, 2003